Remarks:

Reconsideration of the application is requested.

Claims 1-7, 9-22, and 67-68 are now in the application. Claims 1-6 have been amended. Claim 8 has been canceled. Claims 67-68 have been added.

In item 6 of the above-identified Office action, the Examiner has rejected claims 2-5 as being indefinite under 35 U.S.C. § 112, second paragraph. More specifically, the Examiner has stated that, "at least partly" as used in claims 2 and 4 is a relative phrase and renders the claims indefinite. Claims 2 and 4 have been amended to remove the phrase "at least partly".

The Examiner rejected claims 3 and 5 for containing undefined phrases, "other carbonized organic fibers" and "other silicides", respectively. These phrases have been deleted from the claims. Accordingly, claims 3 and 5 are now definite.

Accordingly, the specification and the claims meet the requirements of 35 U.S.C. § 112, first and second paragraphs. Should the Examiner find any further objectionable items, counsel would appreciate a telephone call during which the matter may be resolved. The changes are neither provided for

overcoming the prior art nor do they narrow the scope of the claim for any reason related to the statutory requirements for a patent.

In item 8 of the Office action, the Examiner rejected claims 1-3, 5, and 7-12 as being fully anticipated by Tredway et al. (U.S. 5,552,213) under 35 U.S.C. § 102(b). The rejection has been noted and the claims have been amended in an effort to define more clearly the invention of the instant application. Support for the changes is found on page 15, lines 7-8, of the specification.

Before discussing the prior art in detail, a brief review of the invention as claimed is provided. Claim 1 calls for, *inter alia*, a composite material having the following features:

> a ceramic matrix consisting essentially of phases of silicon, carbon, and silicon carbide …

Tredway involves glassy materials. In contrast, the claimed ceramic matrix is made of phases of silicon, carbon, and silicon carbide.

In the Advisory Action dated December 16, 2002, the Examiner argued that the above amendment would be insufficient because

the matrix of Tredway et al. inherently includes silicon, carbon, and silicon carbide.

However, the Examiner has overstated the significance of Tredway et al. Tredway et al. disclose a composite that is a fiber-reinforced glass ceramic matrix composite; *see* col. 2, lines 18-20. The matrix may be any glass or glass ceramic (col. 2, line 59). Tredway et al. specifically disclose glass materials like borosilicate glass, high-silica content glass, aluminosilicate glass, and mixtures thereof (col. 2 lines 61-63). Silica is the term used for silicon oxide, SiO_2; *see* attached copy of Grant & Hackh's Chemical Dictionary, labeled "EXHIBIT A". This matrix does not include elemental Si; *see especially* claim 67. Likewise, it does include elemental carbon (*see especially* claim 68), or silicon carbide. These materials may be present in the composite, as reinforcing fibers, however; *see* col. 3, line 18 et seq.

Furthermore, according to the usual usage, a glass is an amorphous (i.e. non-crystalline) hard, brittle, often transparent material that is a fused mixture of the silicates of alkali and alkaline earth and heavy metals; *see* attached copy of Grant & Hackh's Chemical Dictionary, labeled "EXHIBIT B". The known forms of silicon, silicon carbide, and carbon do not include glasses; *see* attached copy of Grant & Hackh's Chemical Dictionary. Therefore, it would be wrong to assert

that a glass ceramic matrix inherently has phases of silicon, carbon, and silicon carbide.

In addition, Tredway et al. provide no suggestion that a glass or glass ceramic matrix inherently includes carbon, silicon, or silicon carbide.

Accordingly, none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Therefore, claim 1 is patentable over the art. Moreover, because all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

In item 10 of the Office action, the Examiner rejected claims 4, 6, and 13-22 as being unpatentable over Tredway in view of Beier et al. (U.S. 6,316,086) under 35 U.S.C. §103(a). Claims 4, 6, and 13-22 ultimately depend on claim 1. For the reasons stated above, claim 1 (and therefore the claims depending therefrom) is patentable over the cited art. More specifically, Beier is directed to glass matrix composites. In contrast, amended claim 1 involves, "A ceramic matrix consisting essentially of phases of silicon, carbon, and silicon carbide." Furthermore, while Beier mentions using SiC, BN, boron carbide, titanium carbide, carbon, and silicon as fillers (*see* col. 5, lines 1-17 and 26-43), the phrase

"consisting essentially of" in amended claim 1, avoids any such suggestion from Beier.

Claim 6 has been amended to remove the reference to aluminum.

Claim 8 has been deleted to prevent a repeated claim and not for reasons relating to the prior art.

In view of the foregoing, reconsideration and allowance of claims 1-7, 9-22, and 67-68 are solicited. In the event the Examiner should still find any of the claims to be unpatentable, please telephone counsel so that patentable language can be substituted. In the alternative, the entry of the amendment is requested as it is believed to place the application in better condition for appeal, without requiring extension of the field of search.

Please charge any fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

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Version with Markings to Show Changes Made:

In the Claims:

Cancel claim 8.

Claim 1 (thrice amended). A composite material, comprising:

a ceramic matrix [predominantly including at least one substance selected from the group consisting of carbon, silicide, boron, aluminum, zirconium, silicon carbide, silicon nitride, boron nitride, boron carbide, SiBCN, TiC, iron silicides, and other silicides] consisting essentially of phases of silicon, carbon, and silicon carbide; and

fiber bundles having two different fractions including a reinforcing fiber bundle fraction and a matrix fiber bundle fraction having lengths with different averages, each of said fiber bundles having a weight, said weights being proportional to said fiber bundle lengths, said weights being plotted on a total fiber bundle distribution, and said fractions of fiber bundles being separated by a minimum in said total fiber bundle distribution.

Claim 2 (amended). The composite material according to claim 1, wherein at least a portion of said fiber bundles [at least partly] have at least one protective layer.

Claim 3 (twice amended). The composite material according to claim 1, wherein said fiber bundles contain fibers selected from the group consisting of carbon fibers, graphite fibers, SiC-fibers, aluminum oxide fibers, $Al_2O_3SiO_2$-fibers, $Al_2O_3SiO_2B_2O_3$-fibers, carbonized cellulose fibers, carbonized wood fibers, [other carbonized organic fibers] and fibers resistant to elevated temperatures based on compounds containing Si,C,B,N,Al.

Claim 4 (amended). The composite material according to claim 1, wherein said fiber bundles contain at least one of nano fibers, whiskers and nanotubes [at least partly in place of fibers].

Claim 5 (amended). The composite material according to claim 1, wherein said ceramic matrix <u>additionally</u> contains phases of at least one [substance selected from the group consisting] of [carbon, silicon, boron,] aluminum, zirconium [and alloys selected from the group consisting of silicon carbide] , silicon nitride, [silicon oxide,] boron nitride, boron carbide, SiBCN, Al_2O_3, ZrO_2, TiC, <u>and</u> iron silicides[, other silicides and glass-ceramics].

Claim 6 (amended). The composite material according to claim 5, wherein said ceramic matrix contains additions selected

from the group consisting of iron, chromium, titanium, molybdenum, and nickel [and aluminum].

Add the Following Claims:

--67. The composite material according to claim 1, wherein said phases of silicon in said ceramic matrix are elemental silicon.--

--68. The composite material according to claim 1, wherein said phases of carbon in said ceramic matrix are elemental carbon.--

GRANT & HACKH'S

CHEMICAL DICTIONARY

[*American, International, European and British Usage*]

Containing the Words Generally Used in Chemistry, and Many of the Terms Used in the Related Sciences of Physics, Medicine, Engineering, Biology, Pharmacy, Astrophysics, Agriculture, Mineralogy, etc.

Based on Recent Scientific Literature

FIFTH EDITION
Completely Revised and Edited by

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McGRAW-HILL BOOK COMPANY

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Milan Montreal New Delhi Panama
Paris São Paulo Singapore
Sydney Tokyo Toronto

TABLE 81. TRADITIONAL UNITS WITH SI EQUIVALENTS

Quantity	Unit	Equivalent
length	angstrom	10^{-10} m
	inch	0.0254 m
	foot	0.3048 m
	yard	0.9144 m
	mile	1.609 34 km
	nautical mile	1.852 00 km
area	square inch	645.16 mm^2
	square foot	0.092 903 m^2
	square yard	0.836 127 m^2
	square mile	2.589 99 km^2
volume	cubic inch	$1.638\,71 \times 10^{-5}$ m^3
	cubic foot	0.028 316 9 m^3
	U.S. gallon	0.003 785 412 m^3
	U.K. gallon	0.004 546 090 m^3
mass	pound	0.453 592 37 kg
density	pound/cubic inch	$2.767\,99 \times 10^4$ kg m^{-3}
	pound/cubic foot	16.0185 kg m^{-3}
force	dyne	10^{-5} N
	poundal	0.138 255 N
	pound-force	4.448 22 N
	kilogramme-force	9.806 65 N
pressure	atmosphere (standard)	101.325 kPa
	torr (1 mmHg at 0°C)	133.322 Pa
	pound (f)/sq in. (psi)	6894.76 Pa
energy	erg	10^{-7} J
	calorie (I.T.)	4.1868 J
	calorie (15°C)	4.1858 J
	calorie (thermochemical)	4.184 J
	Btu (I.T.)	1055.06 J
	foot poundal	0.042 1401 J
	foot pound (f)	1.355 82 J
power	horsepower	745.70 W
temperature	degree Fahrenheit	(°F − 32) + 273.15 K

gas, b.1.8. **chloro ~°** SiH_3Cl = 66.6. Colorless gas, b.−30. **chloromethyl ~°** $MeClSiH_2$ = 80.4. A volatile liquid, decomp. by water to silica; used to make textiles water-repellent. **di ~°** Si_2H_6 = 62.2. Silicoethane, a gas, m.−132, b.−15. **dibromo ~°** SiH_2Br_2 = 189.9. Colorless liquid, d.2.17, b.66. **dichloro ~°** SiH_2Cl_2 = 101.0. Colorless gas, b.8.3. **dimethyl ~°** Me_2SiH_2 = 60.2. Colorless gas, b.−20. **ether ~** $(SiH_3)_2O$ = 78.2. Disilane oxide. Colorless gas, b.15. **ethoxytriethyl ~** Et_3SiOEt = 160.3. Triethylsilane ethyl oxide, triethyl silicol ethyl ether. Colorless liquid, b.153, insoluble in water. **hexafluorodi ~°** Si_2F_6 = 170.2. A gas, m.−19. **hydroxy ~** Silicol. **methyl ~°** $MeSiH_3$ = 46.14. Methylmonosilane. Colorless gas, b.−57. **tetra ~** Si_4H_{10} = 122.4. Silicobutane. Liquid, m.−88, b.107. **tetrabromo ~°** Silicon bromide (1). **tetrachloro ~°** Silicon chloride (1). **tetraethyl ~°** Et_4Si = 144.3. Silicon tetraethyl, siliconononane. Colorless liquid, d.0.7682, b.153. **tetrafluoro ~°** Silicon fluoride (1). **tetraiodo ~°** Silicon iodide (1). **tetramethyl ~°** Me_4Si = 88.2. Silicon tetramethyl. Colorless liquid, d.0.645, b.27. **tetraphenyl ~°** Ph_4Si = 336.5. Silicon tetraphenyl, tetraphenyl silicon. Colorless crystals, m. 233. **tri ~** Si_3H_8 = 92.3. Silicopropane. A gas, m.−117. **tribromo ~°** $SiHBr_3$ = 268.8. Silicobromoform. Colorless liquid, d.2.7, b.109. **trichloro ~°** Silicochloroform. **trichloroethyl ~°** $EtSiCl_3$ = 163.5. Colorless liquid, d.1.239. **trichlorophenyl ~°** $PhSiCl_3$ = 211.6. Colorless liquid, d.1.326, b.197, decomp. in water. **triethyl ~°** Et_3SiH = 116.3. Triethyl silicon, silicoheptane. Colorless liquid, d.0.751, b.107, insoluble in water. **trifluoro ~°** $SiHF_3$ = 86.1. Silicofluoroform. Colorless gas, b.−80. **triiodo ~°** SiI_3H = 409.8. Silicoiodoform. Red liquid, d.3.314, b.220.

s.diol A disubstituted chlorosilane of the type $R_2Si(OH)_2$. Silanediols condense to form chain or ring structures. **s.diyl°** Silylene†, silicylene. The radical $-SiH_2-$, from silane. **s.triol** A hydrolysis product of a monosubstituted chlorosilane of the type $R{\cdot}Si(OH)_3$. Silanetriols condense to form 3-dimensional polymeric resins. **s.triyl°** The radical $RSi{\equiv}$; as, methyl silanetriyl.

silanes° Silican(e)s, silicohydrides, hydrosilicons. The branched or unbranched silicon hydrides. Compounds similar to hydrocarbons, in which tetravalent Si replaces the C atom; as, SiH_4, silane. S. are very reactive, ignite in air, and form derivatives. See *silane*.

silanol Silicol. The trivalent group $\equiv SiOH$.

Silastic Trademark for a heat-stable silicone.

silavans Group name for colorless, high-melting-point, strong polymers, containing silicon, carbon, and nitrogen.

silbamin Silver fluoride.

Silberrad, Oswald John (1878–1960) British chemist, noted for his work on explosives.

Silesia explosive A high explosive: potassium chlorate 75, nitrated resin 25%.

silex A heat- and shock-resistant glass (98% quartz). liquid ~ Water glass.

Sil-Foe Trademark for an alloy, m.625–705: Cu 80, Ag 15, P 3%; used for brazing alloys containing copper.

silica SiO_2 = 60.1. Silicon dioxide°, silicic acid anhydride. Occurs abundantly in nature (12% of all rocks), and exists in

TABLE 82. UNITS ALLOWED IN CONJUNCTION WITH SI SYSTEM

Quantity	Unit	Symbol	Definition
angle	degree	°	(π/180) rad
	minute	′	(π/10,800) rad
	second	″	(π/648,000) rad
area	barn*	b	10^{-28} m²
	are*		10^{2} m²
concentration (amount of substance)	—	*M*	10^{3} mol/m³ = mol/dm³
energy	electronvolt	eV	1.602 1892 × 10^{-19} J
	erg*	erg	10^{-7} J
	kilowatthour*	kWh	3.6 MJ
force	dyne*	dyn	10^{-5} N
illuminance	phot*	ph	10^{4} lx
length	angstrom*	Å	10^{-10} m = 10^{-1} nm
	astronomical unit	AU	149,597.9 × 10^{6} m
	micron*	μm	10^{-6} m
	parsec	pc	30.857 × 10^{15} m
magnetic flux density	gamma*	γ	10^{-9} T
mass	ton	t	10^{3} kg = Mg
	unified atomic mass	u	1.660 5655 × 10^{-27} kg
pressure	bar*	bar	10^{5} Pa
radiation dose:			
exposure	roentgen	R*	2.58 × 10^{-4} C/kg
absorbed	rad	rd*	0.01 Gy
radioactivity	curie	Ci*	3.7 × 10^{10} Bq
temperature	degree Celsius	°C	K
time	minute	min	60 s
	hour	h	60 min = 3600 s
	day	d	24 h = 86,400 s
	year	a	see *year*
viscosity:			
dynamic	poise*	P	10^{-1} Pa s
kinematic	stokes*	St	10^{-4} m²/s
volume	liter, litre	l, L	10^{-3} m³ = dm³

*Indicates units to be abandoned as quickly as possible.

6 crystalline forms. Classification: (1) Phenocrystalline or vitreous minerals; see *quartz, cristobalite*, (2) Cryptocrystalline and amorphous minerals; see *chalcedony*. (3) Amorphous and colloidal minerals; see *opal*. amorphous ~ Colorless powder, m.1650, insoluble in water, soluble in hot alkalies or hydrofluoric acid; used for chemical glassware. colloidal ~ See *colloidal silicon dioxide* under *silicon dioxide*. crystalline ~ Colorless, transparent prisms, m.1760, insoluble in water, soluble in hydrofluoric acid. Used in optical instruments, kitchenware, and chemical plant. The main crystalline forms (quartz, tridymite, and cristobalite) have definite transition points (870 and 1470°C, respectively).

s. brick A firebrick containing over 92% s.; its crystalline phase is cristobalite and tridymite. s. gel Gelatinous s. which, if activated, absorbs water. Used to dry blast-furnace gases, air, and other gases; also in pharmacy (NF). s. minerals Rock-forming minerals comprising the groups: amphiboles, andalusite, cancrinite, sodalite, chlorite, feldspar, garnet, iolite, leucite, melilite, mica, nephelite, olivine, pyroxene, scapolite, topaz, tourmaline, zeolite, zoisite; also beryl, quartz, serpentine, talc. s. rock Hard, compact, quartzitic sandstones and quartzite, used for refractories. s. sand A commercial source of silica produced from sand and weakly cemented sandstone deposits (Carboniferous onwards). Used for foundry molding and glass manufacture.

silicam $Si(NH)_2$ = 58.1. Silicon diimide. White powder, insoluble in water. Forms silicon nitride, Si_3N_4, when heated.

silicane See *silane, silanes*.

silicate* Indicating silicon as the principal atom(s) in an anion, as, a salt derived from silica or the silicic acids. Silicates form the largest group of minerals (see *silica*), and are derived from M_4SiO_4, *ortho*silicate*, and M_2SiO_3, *meta*silicate*, which may combine to form *poly*silicates. Except for the alkali silicates, they are insoluble in water. See *silica minerals*. fibrous ~ natural f. s. Asbestos. man-made f. s. Glass, silica, and aluminosilicate fibers, rock wool, slag wool.

s. garden See *chemical garden*. s. of soda Sodium silicate.

siliceous Containing silica. s. algae See *siliceous algae* under *algae*. s. deposit S. sinter. The solid accumulation of silica deposited from hot mineral springs. Cf. *geyserite*. s. earth Silica of diatomite origin, purified by boiling with dilute acid, washing, and calcining; a filter medium and component of dusting powders (NF). s. sinter S. deposit.

silicic (1) Containing silicon. (2) Containing silicic acid. s. acid See Table 83. H_4SiO_4 = 96.1. Orthosilicic acid*. White powder, slightly soluble in water. di ~* $H_6Si_2O_7$. Pyro s. a. White, insoluble powder. meta ~* $(H_2SiO_3)_n$ = (78.1)n. Hypothetical acid corresponding to long-chain anions.

TABLE 83.
SILICIC ACIDS

H_4SiO_4 = $SiO_2 \cdot 2H_2O$, ortho~*	
$(H_2SiO_2)_n$ = $nSiO_2 \cdot nH_2O$, meta~*	
$H_6Si_2O_7$ = $2SiO_2 \cdot 3H_2O$, di~*, pyro~	
$H_4Si_3O_{10}$ = $3SiO_2 \cdot 6H_2O$, tri~*	
$H_{2n}Si_nO_{3n}$ = cyclic ~	

tri ~ ° $H_6Si_3O_{10}$ = 250.3. White, insoluble powder. tetrahydrogen decawolframo ~ ° $SiO_2 \cdot 10WO_3 \cdot 2H_2O$ = 2415. Silico(deci)tungstic acid. White powder; a reagent for cesium (insoluble salts).

silicide Compounds of the type M_xSi_y, as, Mg_2Si, $CaSi_2$, Fe_3Si.

silicification The gradual replacement of rocks or fossils by silica. Cf. *petrifaction*.

silicified Describing an organic material, e.g., wood, that has been petrified.

silicium Silicon.

silico- Prefix indicating silicon, generally in organic compounds. s.benzoic acid PhSiOOH = 138.2, m.92, insoluble in water. s.bromoform $SiHBr_3$ = 268.8. Heavy, colorless liquid, d.2.7, b.116, decomp. by water. s.butane See *silanes*. s.calcium A product of the electric furnace used to deoxidize steel. s.chloroform $SiHCl_3$ = 135.5. Colorless liquid, d.1.34, b.34, decomp. by water. s.dectungstic acid Tetrahydrogen decawolframosilicic acid. s.ethane See *silanes*. s.fluoride Hexafluorosilicate°. s.fluoric acid Hexafluorosilic acid°. s.heptane Triethyl silane°. s.hydrides Silanes°. s.iodoform $SiHI_3$ = 409.8. Heavy, colorless liquid, d.3.4, b.220, decomp. by water. s.methane Silane°. s.oxalic acid HOOSi·SiOOH = 122.2. White, unstable solid.

silicol R_3SiOH. Hydroxysilane. triethyl ~ Et_3SiOH = 132.3. Silicoheptyl alcohol. Colorless liquid, b.154, insoluble in water.

silicon° Si = 28.0855. Silicium. A nonmetallic element of the carbon group, at. no. 14. Allotropic modifications: (1) *Amorphous:* Brown powder, d.2.35. (2) *Crystalline:* Gray crystals, m.1412, b. ca. 2480, insoluble in water. (3) *Graphitoidal:* Dense crystals, or graphitelike masses deposited from molten s. (4) *Adamantine:* Hard needles. Principal valency 4. S. forms many complex compounds on the earth surface (rocks). Used in alloys to impart hardness, and in semiconductors. See *silica minerals*. ethyl ~ The radical ⊐SiEt. Cf. *silanes*. methyl ~ The radical ⊐SiMe. radio ~ A s. isotope, mass 27. Cf. *radioelements*.

s. alkyls (1) Hydrogen compounds of s. corresponding with hydrocarbons; as, SiH_4, silane. (2) Organic compounds of s. and alkyl radicals; as, Me_4Si. See *silanes*. s. alloys Noncorrodible alloys of s. with metals; as, Duriron. Cf. *silicon copper*. s. borides SiB_3, SiB_4, and SiB_6 exist. Black, irregular crystals, of high m.; very hard, and good conductors of electricity. s. bromides (1) $SiBr_4$ = 347.7. S. tetrabromide°. Colorless, fuming liquid, b.154, decomp. by water to silicic acid. (2) Si_2Br_6 = 535.6. S. tribromide°. Colorless solid, b.240, decomp. by water. s. bronze A noncorrodible alloy: Cu, Sn, with 1–4% Si. s. carbide° SiC = 40.10. Colorless plates, dissociates 2250; used in refractories and abrasives. s. chip A wafer of pure s. printed with alternate insulating and semiconducting layers, on which the pattern of an electric circuit is etched. Wafers fused together can contain thousands of circuits. s. chlorides (1) $SiCl_4$ = 169.9. S. tetrachloride°. Colorless, fuming liquid, d.1.524, b.58, decomp. by water to silicic acid. Used in electrotechnics, and mixed with ammonia vapors, in smoke screens. (2) Si_2Cl_6 = 268.9. S. trichloride, b.146, decomp. by water. (3) Si_3Cl_8 = 367.9. S. octachloride°. White powder. s. controlled rectifier SCR. Thyristor. A fast-acting switching device made from 4 alternate layers of n- and p-type silicon. s. copper An alloy: Si 20–30, Cu 70–80%, used in metallurgy. s. dioxide° Silica. colloidal ~ Used in pharmacy as a suspending agent and stabilizer (NF). s. disulfide° SiS_2 = 92.2. White needles, sublime when heated, decomp. by water. s. ethane See *silanes*. s. ethyl Tetraethyl*silane*°. s. fluorides (1) SiF_4 = 104.1. S. Tetrafluoride°. Colorless, suffocating gas, b_{1810mm} −65, decomp. by water to hexafluorosilicic acid, soluble in alcohol. (2) Si_2F_6 = 170.2. S. subfluoride. White powder. s. hydrides Silanes°. s. iodides (1) SiI_4 = 535.7. S. tetraiodide°. Colorless solid, m.121, insoluble in water. (2) Si_3I_8 = 817.6. S. subiodide. Colorless solid, m.250 (in vacuo), decomp. by water. s. iron Ferrosilicon. Iron containing 2–15% Si; used in metallurgy. s. magnesium See *magnesium silicide*. s. methane Silane°. s. methyl Tetramethyl*silane*°. s. nitride Si_3N_4 = 140.3. White powder insoluble in water, existing in 2 hexagonal phases stable below and above 1400–1450° C, respectively. Very resistant to thermal shock and chemical reagents; used as a support for catalysts and in stator blades of high-temperature gas turbines. s. octachloride° See *silicon chlorides*. s. oxide Silica. s. oxychlorides Si_2OCl_6, b.137; $Si_4O_4Cl_8$, b.200; $Si_6O_3Cl_{10}$, b.153; also $(SiOCl_2)_n$·$O(SiCl_3)_2$, where n = 1 to 4. s. ste l Steel containing 2–3% Si; hard and brittle. s. sulfide S. disulfide°. s. tetrabromide° See *silicon bromides*. s. tetrachloride° See *silicon chlorides*. s. tetrafluoride° See *silicon fluorides*. s. tetraiodide° See *silicon iodides*. s. tetraphenyl Tetraphenyl*silane*°. s. tungstic acid Silicotungstic acid. s. zirconium An alloy used to purify molten steel.

silicone (1) Contraction of silicoketone. A polymer containing $-Si(R_2)O-$ groups. Lower molecular weight compounds are oils (used as lubricants and in polishes); higher are inert solids with good electrical insulation properties. (2) $H_3Si_3O_2$ = 119.3. Yellow solid. s. alloy A compound produced by the simultaneous polymerization of 2 silicones; e.g., tetravinyl s. and methyl hydrogen siloxane give a s. alloy of high water repellency. s. release paper Protective backing paper that is easily removed when required, as on self-adhesive labels. s. rubber A s. that retains its elastic properties between −50 and +291, and can be kneaded; used for protective coatings on wires and for high-temperature lubricants.

siliconic acid R·SiOOH, analogous to organic acids. Cf. *carbylic acid*.

·silicono The radical (HO)OSi−, derived from metasilicic acid.

Silicool Trademark for a protein synthetic fiber.

silicosis A form of pneumoconiosis due to silica dust less than 10 μm in diameter. U.K. limit is 0.1 mg/m³ of respirable air.

silicotungstate A salt of silicotungstic acid, especially with the alkaloids.

silicotungstic acid $H_4[SiW_{12}O_{40}]$ = 2878. Tetrahydrogen dodecawolframosilicate°. Dodecawolframosilicic acid°. Yellow crystals, soluble in water; used in alkaloid analysis.

silicyl The silyl° radical. di ~ The disilanyl° radical. s. oxide $(R_3Si)_2O$; as hexaethyl ~ $(Et_3Si)_2O$ = 246.5. Colorless liquid, b.231.

silicylene The silanediyl° radical.

silk (1) Fibroin, sericin. The fibrous envelope of the silkworm before the chrysalis state (cocoon). It consists of fibroin (the fiber protein) and sericin (the gummy protein). (2) A sieve for grading flour: no. 5 = 0.270, no. 8 = 0.190 mm aperture. (3) A series of parallel fine-line inclusions in certain gems (e.g., rubies). Cf. *asterism*. "all-~" S. containing fillers, but no other fibers. artificial ~ Rayon. mat ~ S. fabric made from yarns of continuous s. filament. pure ~ S. fibers without fillers. schappe ~, spun ~ Describing a fabric made from silk-waste staple fiber. vegetable ~ (1) The floss from the seeds of *Calotropis gigantea* (Asclepiadaceae), Asia. (2) Kapok.

EXHIBIT B

$$E = H/nF + T\,dE/dT$$

where E is the emf of the cell, H the heat equivalent of the chemical change for molar quantities expressed in electrical units, F the Faraday constant, T the thermodynamic temperature at which the cell is working, and n the valency, or the number of charges carried by a mole of the substances undergoing change; dE/dT is the rate of change in emf with temperature of the cell. **G., Oliver Wolcott** (1822–1908) American chemist noted for his work on complex compounds. **G. paradox** Work results when 2 gases of thermodynamically identical physical properties (e.g., N_2 and CO) are mixed, but not when 2 portions of the same gas are mixed. **G. phase rule** See *phase rule*.

gibbsite $Al(OH)_3$. A native aluminum hydroxide.

gibrel $C_{19}H_{21}O_6K$ = 384.5. Potassium gibberellate; used to increase the microbial activity of the soil.

Giemsa, Gustav (1867–1948) German chemotherapist. **G. stain** A staining for white blood cells and bacteria: Azur II Eosin 0.3, Azur II 0.8, glycerol 250 g; and 250 mL methanol. **G. ultrafilter** A device for sterilizing and filtering small quantities of biological liquids through a collodion membrane.

giga* G. SI prefix for a multiple of 10^9.

gigantolite A pseudomorph of iolite.

Gilbert G., Sir Joseph Henry (1817–1901) British chemist, noted for agricultural research. G., Ludwig Wilhelm (1769–1824) German chemist, and editor of *Annalen der Physik*. G., Walter (1932–) American chemist, Nobel prize winner (1980). Noted for work on chemical structure of DNA. G., William (1540–1603) British natural philosopher, physician to Queen Elizabeth I, and a pioneer in magnetism and electricity.

gilbert An obsolete unit of magnetic quantity. 1 gilbert = 0.795775 A (the SI unit). **pra ~** See *pragilbert*.

Gilead balm Balm of Gilead, Mecca balsam. An oleoresin from *Balsamodendron gileadense* (Burseraceae). Cf. *poplar buds*.

Giles flask A volumetric flask with long neck, graduated at x and at $(x + 10\%x)$ of its volume; used to prepare normal solutions.

gill A liquid measure: 1 U.S. gill = 118.29 mL = 0.83267 U.K. gill.

gillenia Indian physic, American ipecac. The root bark of *G. trifoliata* or *G. stipulacea* (Rosaceae); an emetic and cathartic.

gilpinite Uranvitriol.

gilsonite Uintaite. A black, brittle, lustrous hydrocarbon mineral.

gin An alcoholic beverage made by distillation of a fermented extract of grain in the presence of juniper leaves. **artificial ~** Fancy g. to which flavoring essences have been added. **fancy ~** A mixture of g. and neutral alcohol.

gingelly Sesame.

ginger Zingiber. The dried rhizome of *Zingiber officinalis* (Scitaminaceae). Asia, W. Indies, Africa; an aromatic, flavoring, and carminative (BP). **Jamaica ~** The yellow roots, with the skin removed. **wild ~** Asarum. **g. oil** The essential oil of g., d.0.882–0.900, b.155–300, containing phellandrene and zingiberene.

gingerin An oleoresin from ginger.

gingerol An essential oil from ginger.

ginkgetin $C_{32}H_{22}O_{10}$ = 566.5. A yellow biflavonyl pigment from the leaves of *Ginkgo biloba*, maidenhair tree, m.343.

ginkgolic acid $C_{23}H_{34}O_3$ = 346.5. (Z)-2-Hydroxy-6(8-pentadecenyl)benzoic acid*. An unsaturated acid from the fruit of *Ginkgo biloba*.

ginning The removal of the larger seed hairs from the cotton plant. Cf. *linter(s)*.

ginseng Panax. The dried roots of *Panax quinquefolium* (Aralia); a reputed tonic that may cause hypertension.

gismondine Gismondite.

gismondite $CaAl_2Si_4O_{12}$. Gismondine, abrazite. A gray, hydrated, monoclinic zeolite, d.2.4, hardness 5–5.5.

gitalin $C_{28}H_{48}O_{10}$ = 544.7. A glucoside, m.253, from digitalis.

githagenin $C_{30}H_{44}O_6$ = 444.4. The aglycone of githagin.

githagin A saponin from corn cockel, *Agrostemma githago*; hydrolyzes to githagenin and glucuronic acid.

gitogenic (1) Having a digitalislike effect. (2) The structure of digitalis aglucones.

gitoxigenin $C_{23}H_{34}O_5$ = 390.5. 3,14,16-Trihydroxy-20(22)-cardenolide. m.222. A split product of gitoxin.

gitoxin A glucoside from the leaves of digitalis; it hydrolyzes to 1 mole gitoxigenin and 3 moles digitoxose.

glacial Describing a compound of icelike, crystalline appearance, especially the solid form of a liquid compound: as, glacial acetic acid.

gladiolic acid $C_{11}H_{10}O_5$ = 222.2. 2,3-Diformyl-6-methoxy-5-methylbenzoic acid*. From *Penicillium gladioli*. Silky needles, m.160; an antibiotic. With ammonia it gives a deep green color, changing after 12 hours to red and then orange.

glair Prepared white of egg used for tempera painting.

glance General term for minerals with a glassy luster, e.g., lead glance.

gland An organ or group of cells that secretes specific substances, e.g., enzymes, sweat, mucus.

Glanzstoff Trademark for a viscose synthetic fiber. Cf. *rayon*.

Glaser furnace A combustion furnace used for organic elementary analysis.

glaserite $Na_2SO_4.3K_2SO_4$. Aphthitalite, arcanite. A colorless, vitreous sulfate, d.2.6, hardness 3–3.5 (Stassfurt).

glass An amorphous, hard, brittle, often transparent material; a fused mixture of the silicates of the alkali and alkaline-earth or heavy metals. See Table 39. Composition: between $(K,Na)_2O$, $(Ca,Pb)O$, $6SiO_2$ and $5(K,Na)_2O$, $7(Ca,Pb)O.36SiO_2$.

TABLE 39. TYPICAL GLASS COMPOSITIONS, %

Composition	Soda, window	Flint	Bottle	Borosilicate	Lead	Aluminosilicate	Silica
(A) SiO_2	71.5	54	74	80.5	35.0	58.7	96.3
Al_2O_3	1.5	—	0.5	2.4	—	22.4	0.4
B_2O_3	—	—	—	12.9	—	3.0	2.9
(B) Na_2O	14.0	—	17	3.8	—	} 1.4	} 0.4
K_2O	—	10	—	—	7.0		
(C) CaO	13.0	—	5	0.4	—	6.0	—
PbO	—	36	—	—	58.0	—	—
MgO	—	—	3.5	—	—	8.5	—

carbodiimide* Hypothedcal compound, NH:C:NH.
Carbofrax Trademark for certain silicon carbide refractories bonded by other ceramics.
carbofuran* See *fungicides*, Table 37 on p. 250, and *insecticides*, Table 45 on p. 305.
carbohydrates Organic compounds synthesized by plants. They often fit the general formula $C_x(H_2O)_y$. *Monosaccharide* (q.v.): *x* and *y* are 2, 3, 4, 5, 6, or 7; e.g., glucose. Disaccharides: *x* is 12, *y* is 11; e.g., lactose. Trisaccharides: *x* is 18, *y* is 16; e.g., raffinose. Polysaccharides: *x* and *y* exceed 18; e.g., dextrin, cellulose. Natural c. are generally dextrorotatory, except fructose and inositol. Conjugated saccharides: (1) gums and mucilage group (saccharides and acids); (2) *glucosides*, q.v. (saccharides and another compound); (3) *tannins*, q.v. (saccharides and tannins). c. catabolism Achieved in animals by *glycolysis*, q.v., followed by an acetyl coenzyme A intermediate and the *citric acid cycle*, q.v.
carbohydrazide Carbonohydrazide*.
carbohydrazones Carbonohydrazides.
carbohydride Hydrocarbon.
carboids Kerotenes.
carbolate Phenolate*.
carbolfuchsin Ziehl's stain, Ziehl-Neelson. Stain for tubercle and similar bacilli, that is not removed by acid, Fuchsin S, phenol 25, alcohol 50, water 500 pts. c. topical solution Castellani's paint, magenta solution. Used to treat skin infections (USP, BP).
carbolic c. acid Phenol*. c. liquid Cresylic acid. c. oil The phenolic fraction of coal tar, b.180–230.
carbolmethyl violet A microscope stain: 10 pts. alcoholic methyl violet 6B, 90 pts. of 5% aqueous phenol solution.
Carbolon Trademark for silicon carbide.*
Carboloy Trademark for cemented tungsten carbide; used for high-speed machine tools and second in hardness to diamond.
carbolxylene A clearing solution: 3 pts. xylene, 1 pt. phenol.
carbomer A polymer of acrylic acid. Fluffy, hygroscopic powder, characteristic odor, soluble in water. A pharmaceutical gel (NF, BP).
carbometer A device to measure carbon dioxide in air.
carbomethane Ketone*.
carbomethoxy The methoxycarbonyl* radical.

carbon* C = 12.011. At. no. 6. A nonmetallic bivalent element; 3 allotropes: amorphous (coal), graphite, and crystalline (diamond). m.3650 (sublimes). It occurs native as coal, graphite, and diamond; in combination with hydrogen as petroleum, with oxygen as c. dioxide. The isotope ^{14}C (half-life period, 5,730 years) is produced by irradiation of tellurium nitride, and is continuously in the atmosphere from the interaction of cosmic rays and nitrogen. See *radiocarbon dating*. Also used to label organic compounds for use as tracers; as in medicine. ^{12}C, the natural, dominant isotope of c., is the basis of the scale of atomic weights of the elements; i.e., $^{12}C = 12$. Cf. *isotopes*. C. is an element essential to vegetable and animal life. Its principal valency is 4, but some divalent c. compounds (carbenes) have been prepared. Its atoms have a greater affinity for one another than for other atoms, and give rise to numerous different (organic) compounds. The binary compounds are carbides, M_xC_y; hydrocarbons, C_xH_y; carbonyls, CO^-. amorphous ~ C. as minute graphitelike crystallites. asymmetric ~ See *stereoisomerism*. fixed ~ The char remaining after removal of the *volatile matter*, q.v., from a fuel. graphitic ~ The loss on ignition of graphite below its fusion point in air. liquid ~ See *liquid carbon* under *liquid*. synthetic ~ See *synthetic graphite* under *graphite*. total organic ~ T.O.C. Measure of effluent strength involving oxidation of the organic c. to CO_2. whetlerized ~ C. containing 8–12% Cu, to increase its absorbency. Cf. *activated c.*, *gas c.*, *charcoal*, *graphite*, *diamond*, *lampblack*.
c. apparatus An instrument to determine total c. in fuels. c. atom *asymmetric* ~ See *asymmetric c.* c. bisulfide C. disulfide*. c. black Lampblack. c. bond The nonpolar electron linkage between 2 c. atoms. c. bronze An alloy for bearings. c. chains A succession of linked c. atoms in a compound. closed ~ Aromatic compounds. open ~ Aliphatic compounds. c. compounds See *organic compounds*. Characteristics: (1) nonpolarity: they do not ionize; their reactions are molecular and have a low velocity; (2) polymerism; (3) isomerism and asymmetry; (4) combustibility: all c. atoms are oxidized to c. dioxide and other products. c. cycle The circulation of c. between a living organism and the surrounding environment is shown in Fig. 6. c. dating See *radiocarbon dating*. c. dichloride* C_2Cl_4 = 165.8. Echylene

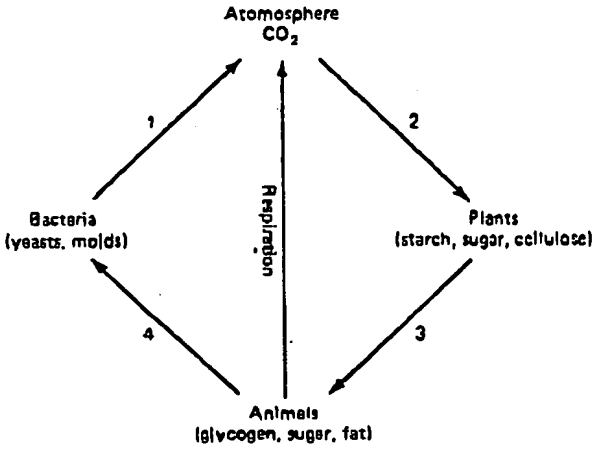

Fig. 6. The carbon cycle: (1) bacterial action, (2) photosynthesis, (3) metabolism, (4) decay.